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Nephelometer Polarizer Experiments on Descent Probes

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We have proposed to develop a polarization nephelometer for use on future planetary descent probes. It will measure both the scattered intensity and polarization phase functions of the aerosols it encounters descending through an atmosphere. These measurements will be taken at two wavelengths separated by about an octave, with one light source near 500nm and another near 1um. Adding polarization measurements to the intensity phase functions greatly increases our ability to constrain the size distribution, shape and chemical composition of the sampled particles. There remain important questions about these parameters of the aerosols on Venus, the giant planets and Titan that can only be addressed with a nephelometer like ours. The NRC Planetary Sciences Decadal Survey has identified probe missions to Venus and Jupiter as a priority. On both of these missions, our proposed instrument would be an excellent candidate for flight. We also expect that future probe missions to Saturn, Uranus, Neptune or Titan would employ our instrument. It could also find use in Earth in situ aerosol studies.

We will use a technique to simultaneously measure intensity and polarization phase functions that uses polarization modulation of a light source. This technique has been implemented in laboratory settings, but not with considerations to the environment on a planetary descent probe. We have proposed to design and build a flexible breadboard nephelometer to test the components and concepts of our approach. We would then test the device against well defined aerosols, ensuring that it accurately measures their expected intensity and polarization phase functions. With the knowledge gained in this flexible design, we would then design and build a breadboard polarization nephelometer more suited to integration on a planetary descent probe. To include traceability in the technical requirements of our device, we would also conduct an Observing System Simulation Experiment. In this study, we would determine what the performance trade-offs are for de-scoping each capability of our instrument. Additionally, it would aid us in optimizing the nominal design parameters to yield the most unambiguous aerosol microphysical information. All of these investigations will be carried out to enhance the likelihood of success and useful data return of our proposed instrument in its descent through a planetary atmosphere. Considerations will also be given to mass, volume, power and cost.